REMARKS/ARGUMENTS:

The above-identified patent application has been amended and Applicants respectfully request that the Examiner reconsider and again examine the claims as amended.

Claims 1 to 11 are pending in the application. Claims 12-15 are new.

Figure 4 is amended herein to reformat the figure by dividing it into Figures 4A and 4B and also to correct an inadvertent duplication of reference character 96, as described above. The proposed change of reference character 96 to 97 in connection with a block labeled "done" in the flow diagram of Figure 4A brings the drawing in line with the specification at page 14, line 11. It is submitted that no new matter is added by the proposed drawing changes. Approval of the proposed drawing changes is respectfully requested. Formal drawings have been submitted under separate cover, a cover of the submission is attached herewith.

Applicants have made several amendments to the specification in order to reflect the reformatting of Figure 4 into Figures 4A and 4B. Additionally, page 3 of the specification has been amended to update the status of the listed application, as requested by the Examiner.

Applicants have amended independent claims 1 and 10 in order to provide antecedent basis for "the n most active of the physical devices" and thereby, to improve the clarity of the claims. This amendment is not made for reasons of patentability.

The Examiner objected to claims 1, 10 and 11 on the bases that "the limitation 'n' is not apparently specifically defined in the disclosure and therefore may be taken to be any reasonable number." Applicants respectfully submit that one of ordinary skill in the

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art would understand from the teaching of the specification that "n" is a user-defined number of the physical devices for which response time optimization is desired. See, for example, page 14, lines 1-3. Accordingly, it is submitted that the objection to the claims should be removed.

Claims 1-11 are rejected under 35 U.S.C.§102(e) as anticipated by or, in the alternative, under 35 U.S.C. §103(a) as obvious over Mason, Jr. et al. (U.S. Patent No. 6,112,257, hereinafter "Mason, Jr.") in view of Saether et al. (U.S. Patent No. 5,333,315, hereinafter "Saether"). Applicants respectfully submit that neither Mason, Jr. nor Saether, whether taken separately or in combination, describes or suggests "determining n most active of the physical devices and for each of the n most active of the physical devices, adjusting a mirror service policy associated with one or more mirrored logical volumes serviced by the physical device to reduce seek time," as set forth in claim 1 or similarly in claim 10, or the storage controller that "for each of n of the most active physical devices, adjusts the mirror service policy associated with a mirrored logical volume serviced by the physical device to minimize seek time when the utilization is greater than a threshold value," as set forth in claim 11.

In fact, the Examiner recognizes that "Mason, Jr. does make a determination of the of the n most active logical volumes (see col. 5 line 16-21), but not of the n most active physical devices." The Examiner relies on Saether as teaching "that monitoring the load of and balancing amongst physical devices would benefit overall system performance, see Saether col. 6, lines 21 – 45" and concludes that "the teaching that physical devices should be monitored and balanced for optimum performance, combined with the teaching that using the n most active elements most directly optimizes without overextending processing and storage required therefor, would have motivated an artisan to determine the n most active devices in Mason, Jr." Applicants respectfully disagree for reasons set forth below.

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It is significant that Mason, Jr. neither describes nor suggests making a determination of the n most active physical devices. As is described in Applicant's Background of the Invention section, Mason, Jr. "sorts logical volumes by activity level, load balances the physical devices based on the activity levels of the logical volumes and minimizes seeks for the logical volumes on the same physical devices." As is further described on page 21, lines 13-17 of the specification and as is illustrated in Fig. 7, "[B]ecause the old scheme has to perform a sort for and evaluate all physical devices logical volume by logical volume, it can only make response time improvements... at intervals of time 't'." In contrast, the claimed method "which evaluates only the n busiest of the physical devices and therefore performs policy updates at a much greater frequency (for example, every 20 seconds), adjusts more quickly to changes in system workload for better response time results." (see the specification at page 21, lines 18–22). Thus, the claimed arrangement provides an advantage in terms of response time which is neither described nor suggested by Mason, Jr., whether considered alone or in combination with Saether.

Saether also does not describe or suggest "determining n most active of the physical devices and for each of the n most active of the physical devices, adjusting a mirror service policy associated with one or more mirrored logical volumes serviced by the physical device," as set forth in claim 1 or similarly in claim 10, or the storage controller that "for each of n of the most active physical devices, adjusts the mirror service policy associated with a mirrored logical volume serviced by the physical device to minimize seek time when the utilization is greater than a threshold value," as set forth in claim 11. Rather, Saether describes "monitoring disk I/O loads and disk capacity and to automatically move files between disks so as to balance either disk loads or disk capacity or both." (col. 6, lines 40 – 45). Thus, Saether does not overcome the deficiency of Mason, Jr. and it is submitted that independent claims 1, 10, and 11, and dependent claims 2-9, are novel over Mason, Jr. and Saether.

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It is further submitted that independent claims 1, 10, and 11, as well as dependent claims 2-9, are not rendered obvious by Mason, Jr. in view of Saether. Applicants respectfully submit there is no motivation to combine the cited references in a manner to arrive at the claimed arrangement for several reasons. First, Mason, Jr. is concerned with minimizing seeks for the logical volumes on the same physical devices in a mirrored logical volume arrangement; whereas Saether is concerned simply with disk I/O load and capacity monitoring and balancing. Thus, one of ordinary skill in the art seeking to solve the problem solved by Mason, Jr. would not look to the teaching of Saether for a solution or an improvement.

Furthermore, there is no recognition in the prior art of the problem solved by Applicant's invention; namely of performing mirror service policy updates at a much greater frequency and adjusting more quickly to changes in system workload for better response time results. (see Specification at page 21, lines 18-22). Thus, one of ordinary skill in the art considering Mason, Jr. in combination with Saether would not be alerted to the possibility of an improvement in the response time results in a dynamic mirror service policy and so, such recognition would not provide the lacking motivation.

Moreover, even if one of ordinary skill in the art were motivated to combine the teachings of Mason, Jr. and Saether, the claimed arrangement would not result. This is because Saether teaches that the disks should be monitored in terms of capacity and I/O loads and files should be moved to balance the disk capacity and the disk loads. Modifying Mason, Jr. to include this function would not impact the manner in which Mason, Jr. dynamically adjusts the mirror service policy by collecting statistics regarding the logical volumes of the system disks, and determining from the collected statistics whether the mirror service policy should be changed. In other words, even assuming that some motivation did exist to combine the teachings of the Mason, Jr. and the Saether references, there is no motivation or suggestion to combine these teachings so as to arrive at the claimed arrangement.

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In view of the above, it is submitted that independent claims 1, 10, and 11 are patentable over Mason, Jr., whether considered separately or in combination with Saether.

Claims 2-9 depend from and thus include the limitations of claim 1. Thus, Applicants submit that claims 2-9 are patentably distinct over the cited references for at least the reasons discussed above in conjunction with claim 1.

It is submitted that claim 3 is further patentably distinct over the cited references since neither reference describes or suggests using a cost function analysis to determine that workload assigned to one or more selected mirrored logical volumes according to a current mirror service policy can be re-assigned to a corresponding mirrored copy according to a new mirror service policy, as set forth in claim 3.

Claim 5 is also further patentable over the cited references since neither reference, whether considered separately or in combination, describes or suggests computing cost functions for each of the physical devices involved in the cost function analysis and determining a maximum value from the computed costs functions, based on the current mirror service policy and a new mirror service policy, as set forth in claim 5. Nor does either cited reference contemplate determining that the reassignment of workload can be made if the maximum value based on the new mirror service policy is less than the maximum value based on the current policy, as set forth in claim 6.

Claims 7 and 8 are further patentable over the cited references since neither reference describes or suggests that adjusting comprises processing the one or more logical volumes in a sequence beginning with the outermost logical volume bordering logical volumes serviced by another physical device, as set forth in claim 7. Nor does either references describe or suggest wherein, for each successive processed logical volume, the new mirror service policy of an immediate predecessor of the processed

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logical volumes is used as the current mirror service policy for the cost function analysis, as set forth in claim 8.

In view of the above, Applicants submit that the rejection of claims 1-11 under 35 U.S.C. §102(e) or, in the alternative, under 35 U.S.C. §103(a) should be removed.

Claims 12-15 are new in the application. Consideration of claims 12-15 is respectfully requested.

In view of the above amendment and remarks, Applicants submit that the claims and the entire case are in condition for allowance and should be sent to issue and such action is respectfully requested.
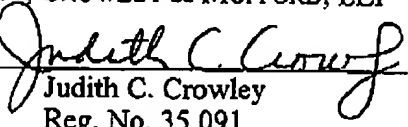
The Examiner is respectfully invited to telephone the undersigning attorney if there are any questions regarding this Amendment or this application.

The Assistant Commissioner is hereby authorized to charge payment of any additional fees associated with this communication or credit any overpayment to Deposit Account No. 500845.

Respectfully submitted,

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start — 80

Collect statistics
for all
physical devices — 82

72

Determine top n
busiest physical
devices — 84

Sort n busiest
physical devices
from most to least
active — 86

Select first
(busiest) physical
device — 88

Select next
(busiest)
physical
device — 98

end of
list ? — 96

N

Y

C

Make temporary
assignment permanent — 94

Done — 97

Y — utilization
< 50% — 93

N

Temporarily assign
volumes in first half
of selected physical
device to that device
and the other volumes
to corresponding mirror(s) — 90

Determine utilization — 92

Select first logical
volume on border
and corresponding
logical mirror copy — 100

B

Compute cost
function for selected
physical device and
physical device(s) with
logical mirrored copies — 102

Determine max.
cost function value — 104

A

FIG. 4A

A

Simulate move (first policy change) — 106

108 — Recompute cost function values

110 — Determine max. cost function value

124 — next logical vol. in sequence

C

Y

122 — Select next logical volume and corresponding mirrored copy

B

112 — Simulate interleaved move (2nd policy change)

114 — Recompute cost functions values

116 — Determine max. cost function value

118 — Determine minimum of the maximum cost function values

120 — Record policy change corresponding to the minimum value

122 — min. is first policy change?

N — C

Y

4B

FIG. 4 (Cont'd)